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(56) References cited:
DE-A-3 228 195
DE-B-1 904 879
FR-A-2 524 935
GB-A-1 314 458
US-A-4 306 525

(73) Proprietor: NISSAN MOTOR CO., LTD.
No.2, Takara-cho, Kanagawa-ku
Yokohama-shi Kanagawa-ken 221 (JP)

(72) Inventor: Inoue, Ryuzaburou
3-9-24, Sakuramori
Yamato City (JP)

(74) Representative: Patentanwälte Grünecker, Kinkeldey, Stockmair & Partner
Maximilianstrasse 58
D-8000 München 22 (DE)

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to a warning system of a motor vehicle, and more particularly to a so-called "oil degradation warning system" which automatically gives a visual or audible warning when the engine oil has been degraded to a certain unusable degree.

2. Description of tha Prior Art

As is known, engine oil functions not only to lubricate movable metal parts, such as pistons or the like, but also to remove haat from heated parts of the engine. However, long usa of the engine oil degrades the nature thereof and thus prevents the oil from exhibiting satisfied lubrication and heat removing functions.

In view of the above, several kinds of oil degradation warning systems have been hitherto proposed, which, by using intake vacuum, oil temparature, and engine speed and/or moved distance as paramatars for estimating tha degradation degree of the engine oil, calculate the time (viz., the oil change time) when tha oil should be changed with new or fresh ona and give a visual or audible warning at that time. Soma of them are disclosed in Japanesa Patent Application First Provisional Publications Nos. 59—27260 and 59—43299.

However, in these hitherto proposed systems, the paramaters as mentioned hareinabove are "totally" treated for calculating the oil change tima, so that it inevitably occurs that the oil change tima is calculated with noticaable error. Thus, in such systams, it somatimas occurs that the warning is givan considerably befora or after the time when the oil change is practically necassary.

SUMMARY OF THE INVENTION

An oil degradation warning systam according to the preamble part of claim 1 is known from DE—A—3 228 195. This referanca disclosas an oil dagradation warning system which comprises first means for datacting a plurality of parameters which are closely ralated to tha dagradation factors of tha angina oil as a first sensor for detecting the engine speed and a sacond sensor for datecting the load on tha angine. Furtharmore, a second maans for processing said paramatars in the form of a calculating means is provided, as well as a third means for issuing an instruction signal in tha form of a judging maans. Finally, tha known oil degradation warning system comprises fourth means in the form of an alarm unit for providing a warning whan the instruction signal is applied thareto.

The calculating means of tha known warning system, howevar, only calculatas ona single dagradation coefficient, namely the amount of suit, in accordance with the detected values of engine speed and engine load. Consaquantly, the judging means of the known system only judges said single coefficient to determine whether a predetermined amount is exceeded.

Therefore, the system known from DE—A—3 228 195 only offers a relatively incorrect method of calculating the oil exchange time and, hence, suffers from the drawback that it inevitably occurs that the oil change time is calculated with noticeable error. Thus, in the known system, it sometimes occurs that the warning is given considerably before or after the time when the oil change is practically necessary.

It is, therefore, an object of the present invention to provide an oil degradation warning system according to the preamble part of claim 1, which can precisaly calculata tha oil exchange time and gives a warning at just the time when the oil exchange is practically necessary.

The solution of this object is achieved by the features of new claim 1.

The oil degradation warning system according to the present invention is considerably improved over the known systems, since it is possibla to monitor a plurality of oil degradation factors. Specifically, tha oil degradation system according to tha prasant invention comprises processing means which ganarate degradation coefficients for a plurality of parameters for aach degradation factor, and integrates the coefficiants for each factor separately over the tima. Thus, it is possible to generata a warning when any one of the plurality of dagradation factors exceeds a predeterminad threshold.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the prasent invention will becoma apparant from tha following description whan takan in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram of an electric circuit employed in an oil degradation warning system of tha present invention;

Figs. 2 and 3 ara flowcharts for carrying out a program sat in the oil dagradation warning systam of tha prasent invantion;

Figs. 4A, 4B and 4C are graphs which show respectively the viscosity dependant oil dagradation coafficiants of oil temparature, engina speed and angina load;

Figs. 5A, 5B and 5C are graphs which show raspectively tha basicity dapandent oil degradation coefficients of oil tamperature, engina speed and angine load; and

Figs. 6A, 6B and 6C are graphs which show respectively tha infusible mattar dapendent oil degradation coefficients of oil temperature, engine spaad and engine load;

DETAILED DESCRIPTION OF THE INVENTION

As will bacome apparent as tha description proceeds, in accordance with the present invention, tha dagrea of oil degradation is estimatad from thraa major factors, which are the viscosity of oil, tha basicity of oil and tha amount of infusible matters in oil. Becausa of difficulty in diractly measuring these factors in consequence

manner, the present invention uses the oil temperature, the engine speed and the engine load as parameters for estimating these factors, that is, for estimating the degree of oil degradation.

Referring to Fig. 1, there is shown a block diagram of the oil degradation warning system 10 according to the present invention. As is seen from the drawing, the system 10 comprises generally a sensor block 12, an input block 14, a microcomputer block 16, an output block 18 and a warning block 20.

The sensor block 12 includes a reset switch 12a, an oil temperature sensor 12b, an engine speed sensor 12c and an engine loed sensor 12d. The reset switch 12a is constructed to issue a reset signal when oil change is practically carried out in the associated engine. The oil temperature sensor 12b is a sensor for detecting the temperature of the engine oil contained in the cylinder block of the engine. The engine speed sensor 12c is a sensor for detecting the rotation speed of the engine. A known crank-angle sensor may be used therefor. The engine load sensor 12d is a sensor for detecting a load applied to the engine, which is, for example, an intake vacuum sensor mounted to the intake part of the engine. If desired, the engine load may be determined by computing signals issued from an air flow rate sensor (not shown) and a next-mentioned engine speed sensor.

As will become apparent hereinafter, the oil temperature sensor 12b, the engine speed sensor 12c and the engine load sensor 12d detect three perameters (viz., oil temperature, engine speed and engine load) which are closely releted to the degradetion factors of the engine oil.

Receiving the information signals from the oil temperature sensor 12b, the engine speed sensor 12c and the engine loed sensor 12d through the input block 14, the microcomputer 16 calculates the oil degredation coefficients of the parameters in each factor and adds end integrates the calculated degradetion coefficients in each factor with passege of time end if et least one of the integrated values exceeds e corresponding reference value which hes been predetermined, the microcomputer 16 issues an output signel to the output block 18. These operations are carried out in accordance with a given program which is depicted by the flowcharts of Figs. 2 and 3. The program is set in a ROM in the microcomputer 16. The computer 16 includes e non-volatile RAM which can memorize the current data even when an ignition switch of the engine is turned off.

The warning block 20 comprises an indicator which issues a visual or eudible warning when the microcomputer 16 issues en output signal to the output block 18.

In the following, the given program will be described with reference to the flowcharts shown in Figs. 2 and 3.

When an ignition switch (not shown) of the associated engine is turned on, the program starts.

At STEP 1, the content of the memory is initialized, and the operation flow goes to STEP 2 where a judgement as to whether or not a reset signal from the reset switch 12a is inputted thereto is carried out. That is, when, due to completion of oil change, the reset switch 12a is actuated, a reset signal is issued from the reset switch 12a and applied to the microcomputer 16 through the input block 14. With this, the operation flow goes to STEP 3 where the integrated values of S_1, S_2 and S_3 are each reset to zero (viz., 0).

It is to be noted that S_1 is the integrated value of oil degradation coefficient dependent on viscosity of oil, and S_2 and S_3 are those dependent on basicity of oil and amount of infusible matters in oil, respectively. This will become clear hereinafter.

Once the reset signal is applied to the circuit, subsequent operation flow goes to STEP 4 without passing through STEP 3. This continues until another oil change is practically carried out.

At STEP 4, a judgement as to whether or not a predetermined time has passed is carried out. This is done by a time counter included in the microcomputer 16. When the predetermined time has passed, the operation flow goes to STEP 5 where the data supplied from the oil temperature sensor 12b, the engine speed sensor 12c and the engine loed sensor 12d are read. And, at this STEP, with reference to the correlations depicted by the graphs of Figs. 4A to 6C, the viscosity dependent oil degradation coefficients (viz., A_1, B_1 and C_1) of oil temperature, engine speed and engine load, the basicity dependent oil degradation coefficients (viz., A_2, B_2 and C_2) of oil temperature, engine speed and engine load, and infusible metter dependent oil degradation coefficients (viz., A_3, B_3 and C_3) of oil temperature, engine speed and engine load are calculated from the data issued from the sensors.

Now, the gradation of engine oil will be outlined from a viewpoint of viscosity, basicity and emount of infusible matters in the oil.

As is known, using the engine oil at high temperature hastens oxidation of the oil and thus increeses the viscosity of the same. Further, edding eny combusted product, such as blowby gas, into the oil increases the viscosity of the seme. On the contrary, adding fuel (gasoline) into the oil reduces the viscosity of the oil. Furthermore, when the oil is stirred vigorously, the viscosity of the oil lowers because any viscosity increasing polymer contained therein is mechanically broken. This phenomenon becomes much severe when a so-called "multigrade oil" is used. As is known, too much lowering and too much increesing of the viscosity of the engine oil induce poor lubrication of the moving metal parts, which sometimes brings about the undesirable piston seizure of the engine. Considering these phenomena, the graphs of Figs. 4A, 4B and 4C are provided.

Figs. 4A, 4B and 4C show the viscosity dependent oil degradation coefficients of oil tempera

ture, engine speed and engine load. As is seen from Fig. 4A, when the oil temperature is high, the viscosity dependent oil degradation coefficient shows a high degree. This is because of increased oxidation of the oil per se. While, when the oil temperature is low, the coefficient is low. As is seen from Fig. 4B, with increase in engine speed, the viscosity dependent oil degradation coefficient lowers. This is because of the mechanical breakage of the viscosity increasing polymer contained in the oil. As is seen from Fig. 4C, the viscosity dependent oil degradation coefficient increases with increase in engine load. This is because of increase of blowby gas with increase in the engine load. (In case of Diesel engine, the amount of smoke increases as the engine load increases).

In the next, the oil basicity dependent oil degradation coefficients will be described. The basicity represents the amount of remaining alkaline additives which neutralize acid matters such as combusted products of sulfer or the like. As is known, poor basicity causes corrosion of metal parts.

Figs. 5A, 5B and 5C show the basicity dependent oil degradation coefficients of oil temperature, engine speed and engine load. As is seen from Fig. 5A, the basicity dependent oil degradation coefficient increases when the oil temperature is relatively low and relatively high. This is because, at low temperature, the oil tends to produce a sludge of metal oxide which reduces the basicity of the oil, while, at high temperature, the oxidation of the oil per se becomes active causing lowering of basicity. The basicity dependent oil degradation coefficients of the engine speed and the engine load have such correlations as depicted by Figs. 5B and 5C respectively.

In the next, infusible matters in the oil will be described. Oxidation products, smoke and metal powders are the infusible matters. The infusible matter dependent oil degradation coefficients of the oil temperature, engine speed and engine load are depicted by Figs. 6A, 6B and 6C, respectively. As is seen from Fig. 6A, the infusible matter dependent oil degradation coefficient of oil temperature increases when the oil temperature is relatively low and relatively high. This is because, at low temperature, metal abrasion phenomenon becomes active, while, at high temperature, oxidation of the oil per se becomes active, both of which cause increase of the amount of the infusible matters in the oil. Regarding to the engine speed, the infusible matter dependent oil degradation coefficient has a nature as shown in Fig. 6B. That is, when the engine speed increases, the amount of blowby gas increases thereby increasing the amount of the infusible matters in the oil. As is seen from Fig. 6C, the infusible matter dependent oil degradation coefficient of the engine load increases with increase of the same. This is because, at high load of the engine, the amount of blowby gas (or smoke in Diesel engine) increases.

It is to be noted that the correlations shown by the graphs of Figs. 4A to 6C are all memorized in the ROM of the microcomputer 16.

Returning back to Fig. 2, at STEP 6, the viscosity dependent oil degradation coefficients (viz., A_1, A_1 and C_1), the basicity dependent oil degradation coefficients (viz., A_2, B_2 and C_2) and the infusible matter dependent oil degradation coefficients (viz., A_3, B_3 and C_3) are each added, and the added values are added to previously integrated values S_1, S_2 and S_3 to provide up-to-date integrated values S_1, S_2 and S_3. Then, the operation flow goes to STEP 7 the detail of which is depicted by Fig. 3 which will be described hereinnext.

As is shown in Fig. 3, at STEP 11, a judgement as to whether or not the up-to-date integrated value S_1 is greater than or equal to a predetermined reference value T_1 is carried out. If YES, the operation flow goes to STEP 12 and a visual or audible warning is produced giving notice of necessity of oil change. If NO at STEP 11, the operation flow goes to STEP 13 where a judgement as to whether or not the up-to-date integrated value S_2 is greater than or equal to a predetermined reference value T_2 is carried out. If YES, the operation flow goes to STEP 12 and thus a warning is issued from the warning block 20. If NO at STEP 13, the operation flow goes to STEP 14 where a judgement as to whether or not the up-to-date integrated value S_3 is greater than or equal to a predetermined reference value T_3 is carried out. If YES, the operation flow goes to STEP 12 and thus a warning is given. If NO, the operation flow returns to STEP 2 bypassing the STEP 12.

As is described hereinabove, in accordance with the present invention, the oil degradation coefficients of the three major parameters (viz., oil temperature, engine speed and engine load) dependent on viscosity of oil, basicity of oil and amount of infusible matters in oil are each integrated with pass of time, and if at least one of the up-to-date integrated values exceeds a corresponding reference value (viz., No Good line), a warning is issued indicating a need of oil change.

Claims

1. An oil degradation warning system comprising:

First means (12b, 12c, 12d) for detecting a plurality of parameters which are closely related to degradation factors of the engine oil, said first means including an engine speed sensor (12c) which senses the rotation speed of the engine and an engine load sensor (12d) which senses a load applied to the engine;

Second means (14, 16) processing said parameters to provide at least one oil degradation coefficient of the parameters and integrating said at least one oil degradation coefficient with a passage of time;

Third means (16, 18) for issuing an instruction signal when the integrated value of the oil degradation coefficient exceeds a corresponding reference value;

Fourth means (20) for giving a warning when said instruction signal is applied thereto, being characterized in

That said first means, furthermore, includes an oil temperature sensor (12b) which senses the temperature of the engine oil;

That said second means (14, 16) processes said parameters to provide a plurality of oil degradation coefficients of the parameters in each factor and integrating same in each factor with a passage of time;

That said third means (16, 18) issues the instruction signal when at least one of the integrated values of the oil degradation coefficients exceeds the corresponding reference value.

2. An oil degradation warning system as claimed in claim 1, in which the oil degradation parameters are the viscosity of oil, the basicity of oil and the amount of infusible matters in oil.

3. An oil degradation warning system as claimed in claims 1 or 2, further comprising fifth means (12a) which resets the integrated values of the oil degradation coefficients to zero when oil change is practically carried out.

4. An oil degradation warning system as claimed in one of claims 1 to 3, further comprising sixth means (step 4 time counter in 10) which judges whether or not a predetermined time passes after said fifth means (12a) completes its work as to resetting the integrated values of the degradation coefficients.

5. An oil degradation warning system as claimed in one of claims 1 to 4, further comprising seventh means (step 1) which initializes a memory when an ignition switch of the associated engine is turned on.

Patentansprüche

1. Ölbeeinträchtigungs-Warnsystem, mit:

einer ersten Einrichtung (12b, 12c, 12d) zum Erfassen einer Mehrzahl von Parametern, die engen Bezug haben zu Beeinträchtigungsfaktoren des Motoröles, wobei die erste Einrichtung einen Motordrehzahlsensor (12c) enthält, der die Drehzahl des Motors erfaßt, und einen Motorbelastungssensor (12d) enthält, der eine Belastung erfaßt, der der Motor unterworfen ist;

einer zweiten Einrichtung (14, 16), die diese Parameter verarbeitet, um zumindest einen Ölbeeinträchtigungskoeffizienten der Parameter bereitzustellen, und die diesen zumindest einen Ölbeeinträchtigungskoeffizienten nach der Zeit integriert;

einer dritten Einrichtung (16, 18) zur Ausgabe eines Befehlssignales, wenn der integrierte Wert des Ölbeeinträchtigungskoeffizienten einen entsprechenden Vergleichswert überschreitet;

einer vierten Einrichtung (20) zur Bereitstellung eines Warnsignales, wenn das Befehlssignal an diese angelegt wird, dadurch gekennzeichnet,

daß die erste Einrichtung außerdem einen Öltemperatursensor (12b) enthält, der die Temperatur des Motoröles erfaßt;

daß die zweite Einrichtung (14, 16) diese Parameter verarbeitet, um eine Mehrzahl von Ölbeeinträchtigungskoeffizienten der Parameter für jeden Faktor zu erzeugen und die diese für jeden Faktor nach der Zeit integriert;

daß die dritte Einrichtung (16, 18) das Befehlssignal ausgibt, wenn zumindest einer der integrierten Werte der Ölbeeinträchtigungskoeffizienten den entsprechenden Vergleichswert übersteigt.

2. Ölbeeinträchtigungs-Warnsystem nach Anspruch 1, bei dem die Ölbeeinträchtigungsparameter die Viskosität des Öles, die Basizität des Öles und die Menge der unschmelzbaren Bestandteile in dem Öl sind.

3. Ölbeeinträchtigungs-Warnsystem nach Anspruch 1 oder 2, mit außerdem einer fünften Einrichtung (12a), die die integrierten Werte der Ölbeeinträchtigungskoeffizienten auf Null zurücksetzt, wenn ein Ölwechsel praktisch ausgeführt wird.

4. Ölbeeinträchtigungs-Warnsystem nach einem der Ansprüche 1 bis 3, mit außerdem einer sechsten Einrichtung (Schritt 4, Zeitzähler in 10), die entscheidet, ob eine bestimmte Zeitspanne vergangen ist, nachdem die fünfte Einrichtung (12a) ihre Arbeit des Rücksetzens der integrierten Werte der Beeinträchtingskoeffizienten beendet hat, oder nicht.

5. Ölbeeinträchtigungs-Warnsystem nach einem der Ansprüche 1 bis 4, mit außerdem einer siebenten Einrichtung (Schritt 1), die einen Speicher in Betrieb setzt, wenn ein Zündschalter des zugehörigen Motors eingeschaltet wird.

Revendications

1. Un système de prévention de la dégradation de l'huile comprenant:

Des premiers moyens (12b, 12c, 12d) pour détecter une pluralité de paramètres qui sont en relation rapprochée avec les facteurs de dégradations de l'huile du moteur, ledit premier moyen comprenant un détecteur de vitesse du moteur (12c) qui est sensible à la vitesse de rotation du moteur et un détecteur de charge du moteur (12d) qui est sensible à la charge appliquée au moteur;

Un second moyen (14, 16) traitant lesdits paramètres pour fournir au moins un coefficient de dégradation de l'huile des paramètres et intégrant au moins un de ces coefficients de dégradation de l'huile avec un déroulement de temps;

Un troisième moyen (16, 18) pour émettre un signal d'instruction quand la valeur intégrée du coefficient de dégradation de l'huile excède une valeur de référence correspondante;

Un quatrième moyen (20) pour déclencher une alarme quand ledit signal d'instruction y est appliqué, caractérisé en ce qu:

Ledit premier moyen, de plus, comprend un détecteur de température d'huile (12b) qui est sensible à la température de l'huile du moteur;

En ce que le second moyen (14, 16) traite lesdits paramètres pour fournir une pluralité de coefficients de dégradation de l'huile des para-

mètres de chaque facteur et intégrant ceux-ci dans chaque facteur avec un déroulement de temps;

En ce que ledit troisième moyen (16, 18) fournit le signal d'instruction quand au moins une des valeurs intégrées des coefficients de dégradation de l'huile excède la valeur correspondante.

2. Un système de prévention de la dégradation de l'huile tel que revendiqué dans la revendication 1, caractérisé en ce que dans ledit système, les paramètres de dégradation de l'huile sont la viscosité de l'huile, l'acidité de l'huile et la quantité de matière non dissolvable présente dans l'huile.

3. Un système de prévention de la dégradation de l'huile tel que revendiqué dans la revendications 1 ou 2, caractérisé en ce qu'il comprend en plus un cinquième moyen (12a) qui replace les valeurs intégrées des coefficients de dégradati n de l'huile quand un changement d'huile est effectué pratiquement.

4. Un système de prévention de la dégradation de l'huile tel que revendiqué dans une des revendications 1 à 3, caractérisé en ce qu'il comprend un sixième moyen (au pas 4 du temporisateur à 10) qui estime s'il est nécessaire ou non de laisser dérouler un laps de temps prédéterminé après que ledit cinquième moyen (12a) ait terminé sa tâche de telle façon à repositionner les valeurs intégrées des coefficients de dégradation.

5. Un système de prévention de la dégradation de l'huile tel que revendiqué dans une des revendications 1 à 4, caractérisé en ce qu'il comprend de plus, un septième moyen (pas 1) qui initialise une mémoire quand le contacteur du démarreur du moteur associé est activé.

FIG. 1

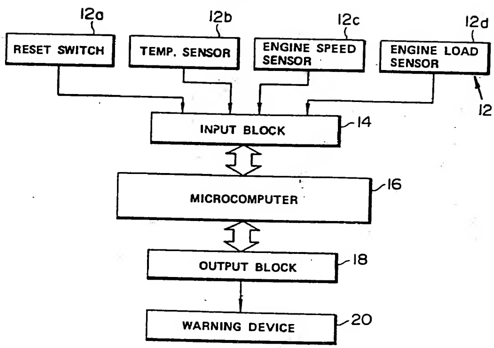
12a
12b
12c
12d
RESET SWITCH
TEMP. SENSOR
ENGINE SPEED SENSOR
ENGINE LOAD SENSOR
12
INPUT BLOCK
14
MICROCOMPUTER
16
OUTPUT BLOCK
18
WARNING DEVICE
20

FIG. 3

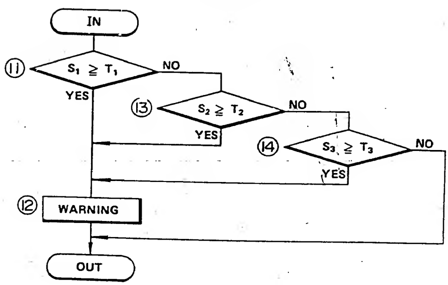
IN
11
S1 ≧ T1
NO
YES
13
S2 ≧ T2
NO
YES
14
S3 ≧ T3
NO
YES
12
WARNING
OUT

FIG.2

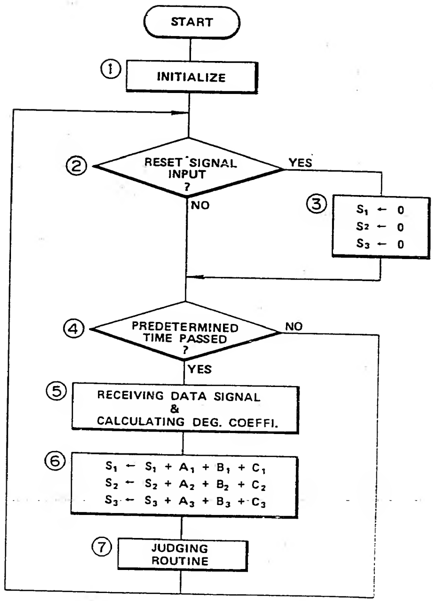
START
1
INITIALIZE
2
RESET SIGNAL INPUT ?
YES
NO
3
S1 ← 0
S2 ← 0
S3 ← 0
4
PREDETERMINED TIME PASSED ?
NO
YES
5
RECEIVING DATA SIGNAL & CALCULATING DEG. COEFFI.
6
S1 ← S1 + A1 + B1 + C1
S2 ← S2 + A2 + B2 + C2
S3 ← S3 + A3 + B3 + C3
7
JUDGING ROUTINE

FIG.4A

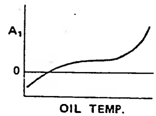

FIG.4B

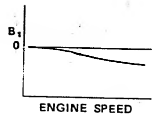

FIG.4C

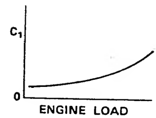

FIG.5A

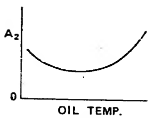

FIG.5B

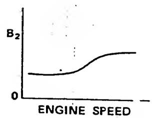

FIG.5C

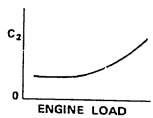

FIG.6A

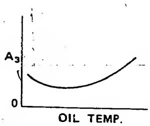

FIG.6B

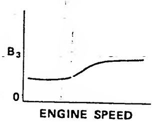

FIG.6C